

What is claimed is:

1. An apparatus for facilitating the recording of data, comprising:

an optical source;

5 a metallic structure having an optical aperture therein, said aperture having a first end and a second end, said first end receiving optical radiation from said source and said second end emitting optical output, said structure having a transmission resonance corresponding to a waveguide mode of said aperture, wherein said transmission resonance is at a frequency that matches a frequency of the optical radiation, thereby enhancing the optical output from said
10 second end beyond what the optical output would be in the absence of said resonance, wherein the emitted optical output includes a near-field portion that extends from said structure out to a distance less than the average wavelength of the emitted optical output; and

at least one element secured to said metallic structure, said at least one element generating magnetic fields whose strength is sufficient to write data in a data recording medium located
15 within the near-field portion.

2. The apparatus of Claim 1, wherein said aperture extends through said structure.

3. The apparatus of Claim 1, wherein said structure includes a protrusion member that directs the optical output onto the recording medium.

4. The apparatus of Claim 1, further comprising a platform to which said structure and
20 said at least one element are secured, wherein said platform is configured to be moved relative to a data recording medium while the separation between said structure and a surface of the data recording medium is kept to less than said average wavelength.

5. The apparatus of Claim 4, wherein said separation is no greater than said near-field distance.

6. The apparatus of Claim 4, wherein said platform is a slider having an air-bearing surface.

7. The apparatus of Claim 1, wherein said optical source comprises a laser and said emission region is located at an output face of said laser.

5 8. The apparatus of Claim 1, wherein said optical aperture is filled with dielectric material.

9. The apparatus of Claim 1, said optical source comprising an optical waveguide coupled to a source of optical radiation.

10 10. The apparatus of Claim 1, wherein said metallic structure includes metal selected from the group consisting of Au, Ag, Cu, Al, and Cr.

11. The apparatus of Claim 1, further comprising a protective coating that adjoins said metallic structure.

12. The apparatus of Claim 1, said structure comprising at least one feature on each of opposite sides of said aperture, said features enhancing the optical output from said structure.

15 13. The apparatus of Claim 12, comprising two of said features.

14. The apparatus of Claim 12, said features including variations in the thickness of said structure.

15. The apparatus of Claim 12, said features including a material other than a material making up the rest of said metallic structure.

20 16. The apparatus of Claim 1, further comprising one or more dielectric coatings that adjoin said metallic structure, said coatings selected to enhance the transmission of the optical radiation through said apparatus.

17. The apparatus of Claim 1, wherein said aperture is a slit.

18. The apparatus of Claim 1, wherein said aperture has a width at its narrowest point of about 10-100 nanometers.

19. The apparatus of Claim 1, further comprising a protrusion member near said second end.

5 20. The apparatus of Claim 1, said at least one element comprising at least one poling piece for applying a magnetic field in a portion of a storage medium as the emitted optical output from said emission region heats the portion.

21. The apparatus of Claim 1, wherein the thickness of said metallic structure is between 100 and 1000 nanometers.

10 22. The apparatus of Claim 1, wherein the dimensions of said aperture are selected to enhance the transmission of the optical radiation at a predetermined frequency.

23. The apparatus of Claim 1, wherein the length of said aperture along an optical axis thereof is approximately $1/4 - 1/2$ that of the average wavelength of the optical radiation from said source.

15 24. The apparatus of Claim 1, wherein said aperture has a spatial dimension that is less than $1/2$ that of the average wavelength of the optical radiation from said source.

25. The apparatus of Claim 1, wherein the optical radiation includes visible radiation.

26. The apparatus of Claim 1, wherein the optical radiation from said source has a full width half maximum (FWHM) of less than about 0.1 times the average wavelength of the optical
20 radiation.

27. A method of directing electromagnetic radiation onto a data recording medium,
comprising:

providing a metallic structure having an optical aperture therein, one end of the aperture
receiving optical radiation and another end of the aperture emanating optical output away from
5 the structure, the structure having a transmission resonance corresponding to a waveguide mode
of the aperture;

directing optical radiation into the aperture at a frequency that matches the transmission
resonance to enhance the optical output; and

directing the optical output onto a data recording medium to facilitate the recording of
10 data.

28. The method of Claim 27, wherein the data is readable by a processor.

29. The method of Claim 27, further comprising applying a magnetic field to the
recording medium to write data into the recording medium.

30. The method of Claim 29, comprising heating the recording medium with the optical
15 output.

31. The method of Claim 30, wherein the dimensions of the aperture are chosen to
enhance, at a predetermined frequency, the optical output.

32. The method of Claim 30, wherein the recording medium is granular and has a grain
size on the order of between 10 and 250 cubic nanometers.

20 33. The method of Claim 27, wherein the recording medium includes a medium selected
from the group consisting of magneto-optic, phase-change, and chemical change media.

34. The method of Claim 27, said directing optical output including positioning the data recording medium and the metallic structure to within a wavelength of each other, wherein the wavelength corresponds to the transmission resonance.

35. The method of Claim 27, wherein the structure includes a protrusion member that
5 directs near-field optical output onto the recording medium.

36. A method of directing electromagnetic radiation onto a recording medium,
comprising:

providing a metallic structure having an optical aperture therein, the structure having a transmission resonance corresponding to a waveguide mode of the aperture;

10 directing optical radiation into the aperture at a frequency that matches the transmission resonance to enhance optical output propagating out of the aperture and away from the structure;

directing the optical output onto a recording medium to heat the recording medium,
thereby facilitating the recording of data; and

reading back the data with a processor.

15 37. A method of directing optical radiation onto a data recording medium, comprising:

providing a metallic structure having an optical aperture therein, the structure having dimensions selected to support optical radiation propagating in a waveguide mode of the aperture;

resonantly coupling optical radiation into the metallic structure, the optical radiation

20 including a frequency that matches a transmission resonance of the waveguide mode; and

directing optical output from the structure onto the data recording medium.

38. The method of Claim 37, wherein the metallic structure adjoins at least one dielectric coating, wherein the thickness of said at least one dielectric coating is selected to enhance the optical output from the aperture.

39. The method of Claim 37, wherein the optical radiation has a wavelength between 390
5 and 2000 nm.

40. A laser, comprising:

an optical gain medium through which optical radiation is amplified; and

a first reflector and a second reflector disposed around said gain medium, wherein one of
said reflectors includes:

10 at least one emission region through which optical output is emitted, wherein said
emission region has a cross section having at least one dimension no greater than an average
wavelength of the optical output; and

a metallic structure having an array of features that couple the radiation to at least
one surface plasmon mode of said structure to increase the emitted optical output from said
15 emission region beyond what the emitted optical output from said emission region would be in
the absence of said features.

41. The laser of Claim 40, further comprising a platform to which said laser is secured,
wherein said platform is configured to be moved relative to a data recording medium while the
separation between said emission region and a surface of the data recording medium is kept to
20 less than said average wavelength.

42. The laser of Claim 41, said platform including an air-bearing surface.

43. The laser of Claim 40, wherein the spacing between said features in said array is chosen to enhance the optical output from said emission region at at least one predetermined frequency.

44. The laser of Claim 40, further comprising at least one element secured to said laser,
5 said at least one element generating magnetic fields whose strength is sufficient to write data in a data recording medium located within a near-field portion of the optical output.

45. A laser, comprising:

an optical gain medium through which optical radiation is amplified; and

a first reflector and a second reflector disposed around said gain medium, wherein one of
10 said reflectors includes:

a metallic structure having an optical aperture therein, said aperture having a first end and a second end, said first end receiving optical radiation from said medium and said second end emitting optical output, said structure having a transmission resonance corresponding to a waveguide mode of said aperture, wherein said transmission resonance is at a frequency that
15 matches a frequency of the optical radiation, thereby enhancing the optical output from said second end beyond what the optical output would be in the absence of said resonance.

46. The laser of Claim 45, further comprising a platform to which said laser is secured, wherein said platform is configured to be moved relative to a data recording medium while the separation between said structure and a surface of the data recording medium is kept to less than
20 an average wavelength of the optical output.

47. The laser of Claim 46, wherein said platform includes an air-bearing surface.

48. The laser of Claim 45, further comprising at least one element secured to said laser, said at least one element generating magnetic fields whose strength is sufficient to write data in a data recording medium located within a near-field portion of the optical output.

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48. The laser of Claim 45, further comprising at least one element secured to said laser, said at least one element generating magnetic fields whose strength is sufficient to write data in a data recording medium located within a near-field portion of the optical output.